

## BRACE FOR ARTICULATED LIMBS

## BACKGROUND OF THE INVENTION

The present invention relates to braces.

In particular, the present invention relates to braces which are used to reinforce parts of the human body to prevent injury thereto, particularly under conditions where the part of the body to which the brace is applied is prone to injury.

For example, in the case of a knee joint which articulates upper and lower leg limbs to each other, under ideal conditions these limbs should only swing one with respect to the other about a single horizontal axis which extends laterally, which is to say, from right to left. However, in certain individuals the knee joint is also undesirably prone to provide for swinging movement of the upper and lower limbs with respect to each other about an axis which may also be horizontal but which extends forwardly and rearwardly. Of course, this latter type of articulation is highly injurious and should be avoided under all circumstances. Thus, the present invention relates particularly to that type of brace which can be used by individuals prone to injurious, undesired joint articulation of this type.

Unfortunately, at the present time, ideal conditions of articulation between limbs at a joint interconnecting the same cannot be achieved with conventional braces. Such braces provide a highly undesirable degree of immobility not only preventing movement of the limbs about an undesired axis, but also preventing, to an undesired degree, movement of the limbs about a single desired axis. Thus, all of the presently known braces represent a compromise according to which the freedom of the limbs to swing about a desired axis is at least partially sacrificed in order to obtain prevention of turning about an undesired axis.

Moreover, conventional braces are relatively heavy, they are difficult to put on and take off, and they cannot readily be maintained at all times reliably in their proper positions.

## SUMMARY OF THE INVENTION

It is accordingly a primary object of the present invention to provide a brace of the above general type which will avoid the above drawbacks.

Thus, it is an important object of the invention to provide a brace which will provide almost unlimited freedom of swinging movement of a pair of jointed limbs one with respect to the other about a desirable single axis, while at the same time reliably preventing any movement of the limbs with respect to each other about any other axis.

In addition, it is an object of the invention to provide a brace composed of a relatively small number of simple components which coact in a highly reliable manner to achieve the complete freedom of articulation about the one desired single axis.

Furthermore, it is an object of the invention to provide a brace of this type which can be readily put on and removed and which also can be very easily held in its proper position.

Furthermore, it is an object of the invention to provide a brace which at all times remains at all of its parts relatively close to the articulated limbs so that the brace will not be readily apparent through articles of clothing, for example.

It is in particular an object of the invention to provide a brace of the above general type which is especially adapted for use at the knee joint.

According to the invention, the brace has a pair of limb-engaging components respectively adapted to engage the articulated limbs at the same side thereof at locations spaced from the joint therebetween. A pair of arms are fixed to and extend from these components, respectively, with the pair of arms terminating in end regions distant from these components. A first pivot means interconnects these end regions of the arms to limit them to swinging movement one with respect to the other about an axis which will coincide with the single axis to which the turning of the limbs is to be limited. A joint-engaging component is adapted to be located directly in engage-

ment with the joint at the side of the limbs opposite from the limb-engaging components. A pair of relatively stiff members extend from the pair of limb-engaging components, respectively, around the joint-engaging component where these members respectively terminate in end regions which are adjacent each other and the joint-engaging component. A second pivot means interconnects the latter end regions and the joint-engaging component all for free turning movement with respect to each other about an axis which also will coincide with the single axis to which the swinging of the limbs is to be limited. Thus, while with this construction an almost completely free, entirely unresisted, freedom of swinging movement of the limbs with respect to each other about the desired single axis can be achieved, the limbs are reliably prevented from turning one with respect to the other about any other axis.

## BRIEF DESCRIPTION OF THE INVENTION

The invention is illustrated by way of example in the accompanying drawings which form part of this application and in which:

FIG. 1 is a perspective illustration of a leg brace of the invention as seen when looking toward the inner limb-engaging surfaces of a pair of limb-engaging components;

FIG. 2 is a side elevation of the brace of FIG. 1 shown mounted on a leg at the knee joint thereof, FIG. 2 showing how the brace appears when looking at the inside of the leg;

FIG. 3 shows the brace at the outside thereof, opposite from the inside which is visible in FIG. 2, also mounted on a leg;

FIG. 4 shows the brace as illustrated in FIG. 2 but with the leg in a different position;

FIG. 5 shows the brace as it appears in FIG. 3 but with the leg also in a position different from that of FIG. 3;

FIG. 6 is a sectional fragmentary elevation taken along line 6—6 of FIG. 1 in a direction of the arrows and showing the details of a pivot means, the parts being shown in FIG. 6 at a scale greater than the illustration thereof in FIG. 1;

FIG. 7 is a fragmentary sectional elevation showing the details of another pivot means of the brace, FIG. 7 being taken along line 7—7 of FIG. 1 in the direction of the arrows and illustrating the structure also at a scale larger than that of FIG. 1;

FIG. 8 is a perspective illustration of the brace of FIG. 1 showing, in addition, bands carried by the brace for fixing the latter releasably on a leg, some of the bands being twisted so as to show the surfaces thereof which carry the releasable fastening structure;

FIG. 9 is a perspective illustration of upper and lower fastening bands with an extension of the lower band extending spirally up to the upper band;

FIG. 10 shows the brace of FIG. 8 mounted on the left leg, as it appears when looking toward the inside of the left leg;

FIG. 11 shows the arrangement of FIG. 10 as it appears when looking toward the front of the leg, from the right of FIG. 10;

FIG. 12 shows the arrangement of FIG. 10 at the outside of the leg opposite from the side thereof which is visible in FIG. 10;

FIG. 13 shows the arrangement of FIG. 10 as it appears when looking toward the rear of the leg, from the left of FIG. 10.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

The drawing illustrates the principles of the invention as applied to a leg brace for protecting the knee joint, but it is to be understood that the principles of the invention are also applicable to other articulated limbs such as upper and lower arm limbs which are articulated at an elbow joint.

Referring to the drawing, there is shown in FIG. 1 a leg brace 10 which includes a pair of limb-engaging components 12 and 14. As is apparent from FIG. 3, these components 12 and 14 are respectively adapted to engage the upper and lower